U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 229.

THE PRODUCTION OF GOOD SEED CORN.

BY

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WITH AN APPENDIX ON

SELECTION AND CARE OF SEED CORN.

BY

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LETTER OF TRANSMITTAL

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., August 8, 1905.

SIR: I have the honor to transmit herewith the manuscript of a paper on the Production of Good Seed Corn, and to recommend that it be published as a Farmers' Bulletin.

This paper was prepared by Mr. C. P. Hartley, Assistant in Physiology, Laboratory of Plant Breeding, and has been submitted by the Pathologist and Physiologist with a view to publication.

Mr. Hartley's paper is intended for those who feel a sufficiently deep interest and who have adequate opportunities to make a specialty of producing high grade seed corn either for their own use or for sale. To this paper has been appended a brief discussion by Dr. Herbert J. Webber intended to be of use to those corn growers who do not feel that they can undertake special work in corn breeding and who may not be able to secure well-bred seed, but who desire to make the most of the opportunity to improve their corn by selecting seed from their field crops and taking proper care of the same.

Respectfully,
B. T. GALLOWAY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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GENERAL DEMAND FOR WELL-BRED SEED CORN.

A large number of letters are received by the Department of Agriculture containing such requests as the following:

Will you please inform me where well-bred seed of a variety of corn suited to this locality can be purchased?

The patient labors during the past century of James Riley, J. S. Leaming, and James L. Reid, and the more recent work of other corn breeders, have made it possible to answer satisfactorily such inquiries from some localities, but the majority of the letters received can not be satisfactorily answered because no corn has been improved for the portions of the United States from which they come.

IMPROVED STRAINS NEEDED FOR DIFFERENT LOCALITIES.

Strains of corn that doubtless had a common origin have become so changed that some of them have a growing period of six months, reaching a height of 18 or more feet, while others ripen in ninety days, having attained a height of only 2 or 3 feet. These changes are the result of selection, which is partly natural and partly the work of man. By selection a strain can be greatly improved in production and at the same time adapted to the soil and climatic conditions of the locality in which it is being improved. Because of differences in soil, climate, and length of growing season, a corn improved in one locality does not afford the best seed for localities which are unlike it. It is therefore essential that we have corn breeders in all sections of the United States.

AN OPPORTUNITY FOR PROGRESSIVE FARMERS.

In the opinion of the writer, the farmer who will produce a productive strain of corn adapted to his section will be able to sell good seed at a price profitable alike to himself and to those who buy, and will become a public benefactor by increasing the production of corn in his neighborhood.

The swindling practice of advertising and selling as well-bred seed a corn that has received no careful breeding is more common than the breeding of productive strains, and has caused many who have been imposed upon to discredit the merits of truly good seed corn. It is unwise to buy seed from parties whose method of corn breeding is unknown and whose truthfulness is not assured, and it is equally unwise to purchase in large quantity seed of a strain of corn that is not known to be adapted to the section in which it is to be planted. When purchasing seed corn it is advisable to insist on receiving it in an unshelled condition.

The object of this bulletin is to outline as simple a method of producing well-bred seed corn of high productive character as present experience and experiments have proved possible. This method is especially adapted to the production of seed corn on a considerable scale either for the use of the grower or for sale to others whose soil and climatic conditions are similar. Of course it is not recommended that every corn raiser follow the method here outlined, but it will pay any farmer who grows corn on a considerable scale to adopt this or some similar method unless he is able to secure improved seed from some reliable local seed-corn breeder. Those who grow less than 20 acres of corn may find it cheaper to pay $3 or even $5 per bushel for well-bred seed, if it can be obtained, than to follow a careful method of corn improvement simply in order to produce their own seed. If no one is breeding corn in the neighborhood, it would probably be advisable and profitable to devote the 20 acres to the raising of well-bred seed for the market. The great difficulty in attempting corn breeding on a small farm is to prevent the strain from being cross-pollinated with other strains grown on surrounding farms. Growers who raise corn extensively can not afford to neglect the opportunity of increasing their production per acre by planting well-bred seed, such growers being usually well situated for breeding a highly productive strain.

IMPORTANT CHARACTERS A CORN SHOULD POSSESS.

Before outlining the method of breeding seed corn it will be well to mention the most important characters of a good corn. The discussion which follows refers to field corn grown as a grain crop, but the method of breeding outlined is also applicable to sweet corns, ensilage corns, pop corns, etc. The minute characters desired in these different kinds of corn vary with the use to which the corn is to be put.

A good corn for any section is a corn that matures in time to escape frost or drought and that produces grain or shelled corn of good quality abundantly. An error is very frequently made in northern sections in attempting to grow a corn that is not sufficiently early in

maturing. On the other hand, a corn should be sufficiently late in maturing to utilize the entire period of good growing weather, as longer growth is favorable to greater production. In the following descriptions of the characters that constitute desirable stalks, ears, and kernels, only the most important characters—those that influence the production of grain per acre—are considered.

DESIRABLE STALKS.

A desirable stalk is one without suckers, or offshoots, thick at the base, with well-developed roots, gradually tapering toward the top, and bearing a good ear or ears slightly below its middle point. It is perhaps not advisable, even in the Southern States, to obtain a taller growth of stalk than 10 feet, and in the extreme North the short growing season does not permit of more than half this growth of stalk. The stalk should be free from smut or other disease, possess well-formed blades, preferably 12 to 16, and have its ear attached by an ear stalk, or shank, not more than 4 or 5 inches in length. Figure 1 illustrates a good stalk and a slender barren stalk which grew singly and but 18 inches apart. One had the same opportunity as the other. Figure 2 shows two very desirable stalks.

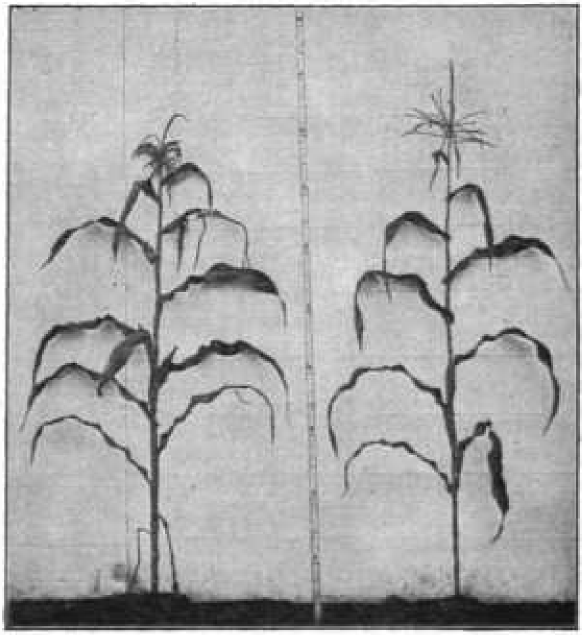

FIG. 1.—A productive and a barren stalk.

It should be borne in mind that the stalk is the individual and that it corresponds to the individual animal, which, with good breeders, is so carefully chosen. Experiments conducted by the Department of Agriculture have demonstrated that important stalk characters, such as height, height of ear, character of root growth, quantity and width of foliage, number of suckers, number of ears per stalk, etc., are transmitted to a strong degree. It is therefore necessary to select seed ears from stalks that are well developed, and this can be done only by selecting from standing stalks at ripening time.

DESIRABLE EARS.

The most important character seed ears can possess is ability to reproduce abundantly a good quality of ears. The possession of certain other desirable characters can be determined by inspection, but this, the most important character, can be determined only by comparative growing tests.

There are many visible characters that a good seed ear should possess, and a corn having them, in addition to the character of great productivity, can be secured by selecting such ears from the progeny of those ears that yield most in the comparative production tests. The improvement of the visible characters of a corn is not as difficult as the improvement in power to yield abundantly, but both can be accomplished at the same time by persistent selection to type from the progeny of the most productive seed ears.

FIG. 2.—Two desirable stalks.

An ear of cylindrical shape, well rounded at each end, affords the largest percentage of grain per cob as well as kernels of the most uniform shape. The cob should be neither too large nor too small, and should possess the property of drying well and quickly, causing it to be of light weight and of a bright, healthy color. The kernels should fit compactly together throughout their full length on both sides and edges, and should be uniform in shape and length on all portions of the ear. Figure 3 illustrates the visible characters of a desirable seed ear. In poorly selected strains of corn undesirable ears of almost every possible size and form occur. Figure 4 illustrates a few undesirable points, such as grains of short and irregular shapes and a poorly developed butt and tip.

DESIRABLE KERNELS.

Length is a very desirable character for the kernels of a corn to possess, as it is by increased length in proportion to the diameter of

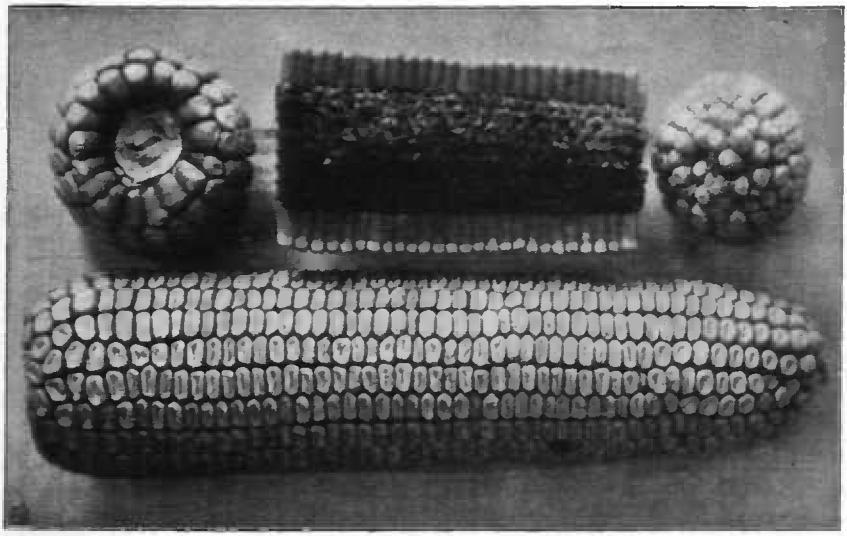

FIG. 3.—Two ears which possess excellent visible characters.

cob that the percentage of grain is increased. Soft, chaffy kernels, though long, or kernels with prolonged chaffy caps, are not desired.

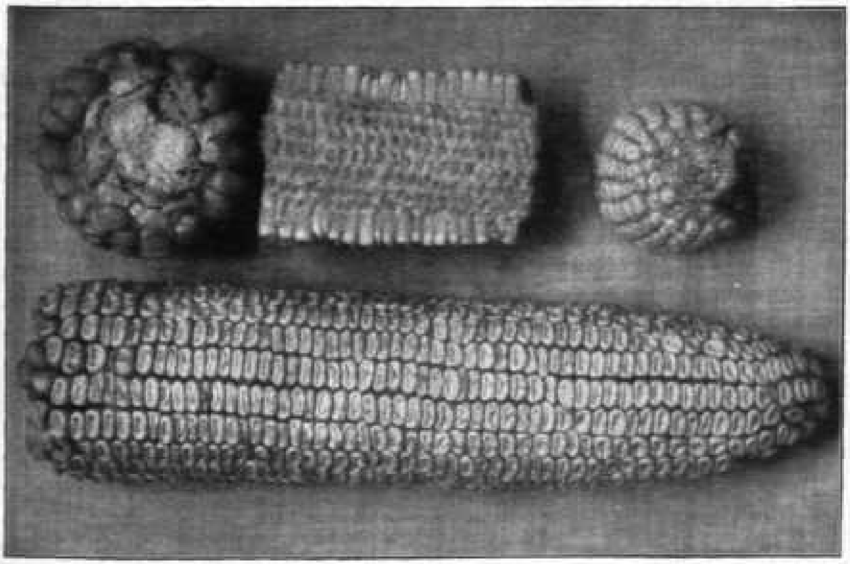

FIG. 4.—Two undesirable ears.

It is much better to select for increased length of kernel than to select for small cob. Selecting for small cob results in reducing the

size of the ear, and it is also an easy matter to reduce the size of the cob to such an extent that the pressure of the kernels causes the ear to break. Figure 5 shows some desirable kernels. The shape is that of a wedge having straight sides and edges. This shape admits of the kernels fitting together so compactly that little or no space is wasted. The germ, the most nutritious portion and the portion in which is located the embryo plant, should be large, smooth, and firm.

METHOD OF CORN BREEDING OUTLINED.

CHOOSING A CORN WITH WHICH TO BEGIN.

It is quite important that the work of breeding a productive strain should be begun with the best corn available. The experience of the farmers of a given locality is valuable in making this choice, and experimental tests made at the State experiment station may help to decide with what corn it is advisable to begin the work. If the soil or climatic conditions are peculiar, it is advisable to begin with a native strain that has become adapted to these peculiarities. If a uniform strain bred in some other locality proves as productive as or more productive than the native strains, it should be given the preference because of its better character.

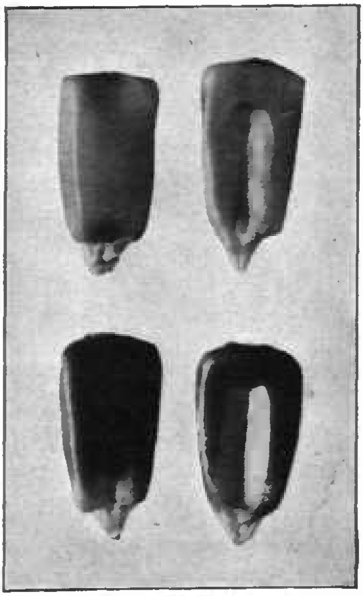

FIG. 5.—Desirable kernels.

SELECTION OF PARENT EARS.

The strain having been decided upon, the next step is to fix in mind the ideal stalk, ear, and kernel, and preserve for reference from time to time a sample ear that approaches most nearly to the ideal. A field of several acres in extent of the kind of corn chosen should be carefully gone through, and a hundred or more desirable ears selected from the most desirable stalks that can be found. This selection should be performed with the same care that an animal breeder would use in selecting sires and dams with which to begin a herd.

WHEN TO SELECT SEED.

If one feature desired be the production of an earlier corn the best time to perform the selection work is at the time the earliest stalks ripen and the ears begin to dry. Seed ears can then be taken from the

earliest stalks, thus causing the strain to grow earlier from year to year. In the central and southern sections the corn can be allowed to become quite dry before gathering seed ears, but the work should not be delayed long after the corn ripens.

CLOSE EXAMINATION OF EARS SELECTED.

The hundred or more desirable ears which have been selected should be placed on boards or tables, with the tips of the ears pointing in the same direction. One by one each ear of the lot should be compared with the sample ear, which should be the one that most nearly approaches the typical ear, and any that do not conform to type should be discarded. Two or more kernels, one a third of the distance from the butt and another the same distance from the tip, should be taken from each ear and examined and measured. If these kernels are too short, or are found defective in any character, the ear should be discarded. Figure 6 shows a simple device that has proved exceedingly convenient in testing the length of kernels. It is made by cutting a notch in the thin portion of a shingle or in a piece of leather and tacking this piece on a table or box. The distance from the shoulder of the notch to a mark on a piece of paper placed beneath represents the length which the kernels must equal or exceed.

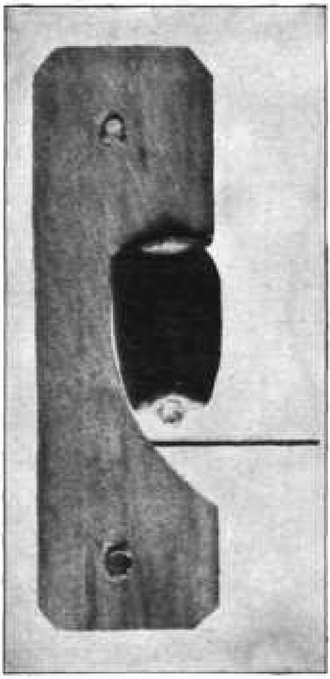

FIG. 6.—Convenient device for testing length of corn kernels.

The ears that have proved suitable should be thoroughly dried and well preserved till nearly planting time, when they should be shelled by hand, the poorly shaped kernels at the extremities being discarded and the good kernels placed in small paper bags, the kernels from each ear in a separate bag.

SELECTING A BREEDING PLAT.

In the breeding plat the best seed ears are planted in separate parallel rows, one ear to each row. This is necessary in order to determine which ears possess the invisible character of great productiveness to the highest degree. One who has never tried this method of planting would suppose that there would be little or no difference among the rows, but the characters of the ancestors reappear with

surprising plainness. Figure 7 shows two rows planted from two ears of the same corn. The ear planted in row 118–2 was borne below the middle of the stalk, while the one planted in row 118–3 was borne above the middle. It will be noticed that this character has been transmitted to the stalks in these progeny rows.

Uniform soil necessary.—It is essential that the soil of the plat be uniform and that the various rows be given the same opportunity in all respects. Dead furrows and back furrows should be avoided. In case they are present, the rows should be planted at right angles to them: otherwise a row close to a dead furrow or back furrow might be placed at a great advantage or as great a disadvantage. If one side of the patch is higher than the other the rows should be planted so that each will have an equal amount of high and low land. These points are exceedingly important, for unless the rows all have an equal chance the results of the test become unreliable.

FIG. 7.—Two rows, each planted with seed from different ears of the same corn.

Soil should be characteristic of the locality.—The breeding plat should be located on land of the same nature and degree of fertility as the farm or the soil in general on which the seed produced in the breeding plat is to be planted. It is a mistake to give the seed plat extra care in the way of heavy fertilization or irrigation. The object of the breeding plat is to increase in a strain of corn the property of

producing heavily under the natural conditions of the locality. This property is transmitted by selecting seed from the progeny of ears that give heaviest yields, not because of having grown on rich soil, but because of possessing an inherent tendency to great production. By locating the seed plat on soil similar to that of the neighborhood the strain of corn from year to year becomes better adapted to soil of that nature.

Isolation.—In all corn-breeding work isolation is essential. The breeding plat should be separated from other kinds of corn, and even from inferior strains of the same kind, by at least 40 rods. A greater distance is safer, though if strips of timber or hills intervene there is less likelihood of the winds carrying to the breeding plat pollen grains from inferior corns. The tasseling of volunteer corn stalks near the breeding plat must be prevented.

Size of plat.—The size of the breeding plat can be suited to the size of the farm and to the labor available for the work. From 40 to 60 corn rows of exactly the same length—from 500 to 600 feet long—would form a plat of very desirable size. If the work be with a small-eared corn it will be necessary to have the rows shorter. A very small breeding plat should not be used. The results of the yields are not so trustworthy, and in planting but a few ears there is less chance of finding one possessing especially high producing power.

PLANTING THE BREEDING PLAT.

It is better to drill the corn in the breeding plat rather than to plant it in hills. If planted in hills it is impossible in some cases to distinguish suckers from the main stalks. The grower should use the utmost care to get a uniform stand of stalks in all the rows. The fertility of the soil and the available moisture will decide how thick the stand of stalks should be,[a] but it should be the same as for other cornfields planted on similar soil. For convenience in labeling the seed selected from the various rows, it is best to number the rows by means of stakes at one end.

Border rows.—In order that all the rows may be similarly situated, a few border rows should be planted entirely around the breeding plat. Such border rows will often protect the breeding rows from depredations of crows, squirrels, chinch bugs, etc.

The seed used in planting the border rows should of course be from very select ears. Usually enough is left of the ears used in planting the breeding rows to plant the border rows.

The breeding plat should be given the same good cultivation that other cornfields require.

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[a] See Farmers' Bulletin 199, U. S. Department of Agriculture, p. 24.

DETASSELING TO PREVENT SELF-POLLINATION.

Before the corn comes into tassel, or even earlier, a few rows may exhibit marked weakness. Such rows should have the tassels pulled from all the stalks as soon as the tassels show plainly in the top of the stalks and before pollen is discharged. In the same manner the tassels should be pulled from all the undesirable stalks in all the rows. Undesirable stalks consist of barren stalks, stalks with many suckers, feeble or very slender stalks, smutty stalks, etc. If detasseled in time the transmission of these characters to the next generation will be prevented.

In order that seed may be selected that has to no extent been self-pollinated, one-half of each row is detasseled. That this may not interfere with proper pollination, it is performed as here illustrated:

Row 1 - ————————————————————
Row 2 ———————————————————— -
Row 3 - ————————————————————
Row 4 ———————————————————— -

Each row is detasseled from one end to the middle, alternating ends of adjoining rows being detasseled.

Figure 8 illustrates the yields of ears from two adjoining rows.

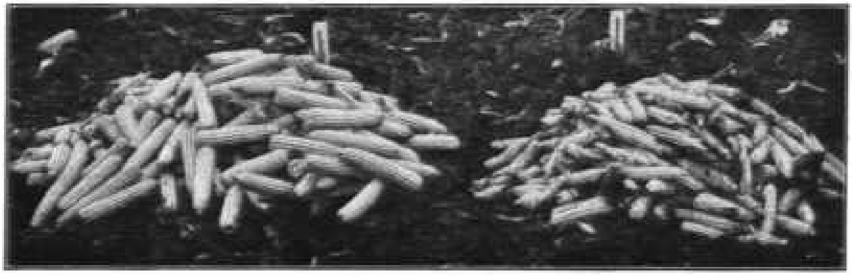

FIG. 8.—Injurious effect of self-pollination shown in pile at right.

The crop on the left was produced by seed from an ear that was hand-pollinated with pollen from another stalk of the same kind of corn; while the crop on the right was produced by seed from an ear that grew on the same stalk as the ear first mentioned, but was hand-pollinated with pollen from the same stalk on which the two ears grew. The difference in the two piles of corn is due to self-fertilization; for all of the many other tests made gave results like those here illustrated. Under ordinary field conditions a portion of the kernels are produced by self-pollination, and there is every reason to believe that those kernels which are the result of self-fertilization are reduced in power of production to the same extent as shown in the illustration. Pulling the tassels from the stalks before they discharge any pollen entirely prevents self-fertilization. In order to do this

work thoroughly, the plat will have to be gone over every two or three days at tasseling time.

COUNTING THE STALKS.

After the detasseling is finished there is no work to be done in connection with the breeding plat until the stalks turn brown and the ears begin to dry. An exact count should then be made and recorded of the total number of stalks, including suckers, contained in each row.

SELECTING SEED FROM THE BREEDING PLAT.

When the majority of the stalks are ripe and the husks and ears are fairly dry, the detasseled portion of each row should be gone over separately and the ears from all desirable stalks gathered, weighed, and at once spread out to dry, the row number being kept with each lot of ears. Of course it is only from ten or a dozen of the most productive rows that we wish finally to retain seed for planting; but, as we can not know the most productive rows until the yield from each row is weighed, it is necessary to select seed from all the rows except those that are conspicuously poor or weak. Such rows should be entirely ignored, as should also any rows that have a poor stand of stalks. This is important, because no test of production can be made unless the stand is quite uniform.

When dry enough to harvest, the ears from each row should be gathered and weighed, and the weight of corn from each row added to the weight of the seed ears that were previously gathered from the same row. This addition gives the total number of pounds produced by each row.

DETERMINATION OF THE MOST PRODUCTIVE ROWS.

It is impossible to secure exactly the same number of stalks in all the rows at harvest time, and the row that contains the most stalks will have the advantage unless the stand is too thick to allow of greatest production. Ignoring the rows that fall much below a perfect stand, the others should be ranked according to their average production per stalk, which is obtained by dividing the number of pounds produced by a row by the number of stalks that grow in the row. The secret of a large corn crop lies in having each stalk produce well. By taking seed ears from detasseled stalks that produce well and which grew from ears of high producing power, progress is made each year in increasing the yielding power of the strain.

Having now calculated the average production per stalk of each row in the breeding patch, except the conspicuously poor ones, the best ears from the ten or dozen highest ranking rows are examined,

kernels measured, etc., as already outlined (p. 11), and six to ten of the very best ears from each of the highest ranking rows preserved for the next year's breeding plat. A similar number of second-best ears are also preserved, as a safeguard against losing the work of previous years in case hail, floods, or insects should destroy the breeding plat. After the improvement has been continued for a few years it is exceedingly important to save this extra supply of seed.

The work as outlined is repeated each year, and the improvement from year to year is very noticeable and gratifying to the breeder.

THE INCREASE FIELD.

It is not supposed that seed in sufficient quantity for general planting or for sale will be obtained from the rows of the breeding plat. The method has been outlined for the purpose of showing how a highly productive strain is originated. To obtain seed for general planting and for sale, an increase field is grown from the remaining seed obtained from the desirable stalks of the detasseled portion of the highest-ranking rows. Due precaution is taken to prevent the increase plat from being cross-fertilized with inferior strains. Otherwise it is planted and cared for as any other cornfield. It is called the "increase field" because it is used to increase the quantity of well-bred seed produced in the breeding plat. The increase field is not grown for the purpose of improving the strain of corn, but solely for the purpose of increasing the quantity of good seed of the strain improved by the necessarily complex method outlined.

The breeding plat will each succeeding season furnish seed more highly improved for planting the increase field. From the increase field seed is obtained in large quantities for general planting and for sale. For these purposes the good seed ears can by some convenient and rapid process be separated from poor ones. This can be done most handily, perhaps, as the wagonloads of corn from the increase field are being unloaded at the cribs.

IMPORTANCE OF FOLLOWING A METHOD OF CORN IMPROVEMENT.

Corn bred for several years for increased production will produce, with exactly the same treatment, 10, 20, or even 40 bushels more per acre than unselected seed. Counting the increase at but 10 bushels per acre, when corn is selling at 40 cents per bushel well-bred seed bears a money value of $24 per bushel and the profit on the corn crop is increased $4 for every acre grown. This estimation is very conservative, the profit often being four times as great. Corn can be considerably improved and rendered quite uniform by selecting from year to year the best ears from the best stalks, without regard to the producing power of individuals or without employing the aid ob-

tained from detasseling. The improvement, however, in such case is not so rapid. Some think it necessary to obtain new seed every few years, claiming that their corn has "run out." A good strain of corn, like a good breed of animals, will "run out" if pains are not taken to propagate from the best individuals. Instead of allowing a strain of corn, through neglect, to "run out," it can be "run up" in producing power by some such system as has been outlined.

CARE OF SEED CORN.

The next step in importance after the growing of good seed corn is its care from the time it is gathered until it is planted. It is advisable that all corn which is to be used as seed—for the breeding plat, for general planting, or for sale—should be preserved in the best manner possible. Good care consists in carefully drying the ears, and at the same time seeing that they dry quite rapidly. This should be done as soon as they are gathered, and they should then be stored in a dry place of even temperature and where they will not be reached by damp air. Seed corn, although it may have become very dry, will absorb moisture if it comes in contact with a damp atmosphere. When first gathered, seed corn often contains 20 to 25 per cent of moisture, and may be greatly injured in one day's time if allowed to freeze or to heat.

One of the most satisfactory ways of drying seed corn is to place it in thin layers on a series of floors made of narrow strips of board laid just close enough together to keep the ears from falling through. These floors should be in a shed or building that can be well ventilated, and preferably one which can be closed during damp weather.

In northern sections, where freezing weather comes as soon as the corn has matured, or even before, artificial heat is needed to keep the corn from freezing; but the heat should be used in connection with an abundance of dry air, as corn is not dried by heating, unless a means is provided for the moist air to pass out.

In southern sections, usually no trouble is encountered in drying seed corn, but it often becomes necessary to treat it in order to prevent its destruction by weevils, grain and flour beetles, and the Angoumois grain moth. For this purpose the Bureau of Entomology advises the use of bisulphid of carbon at the rate of 1 pound of the insecticide to 100 bushels of grain. The fumigation is made in a bin or a specially prepared box or other receptacle made as air-tight as possible. The bisulphid is allowed to evaporate from plates or dishes, and the exposure lasts from twenty-four to forty-eight hours. The corn should not be fumigated until dry, as it is likely to heat. Full directions for the use of bisulphid of carbon as a remedy for weevils in stored grain are given in Farmers' Bulletin No. 45, which may be obtained by application to the Secretary of Agriculture. The use

of bisulphid of carbon is further discussed in detail in Farmers' Bulletin No. 145. The bisulphid is very inflammable and even explosive when mixed with air under certain conditions, and must therefore be handled with great caution. Before using it, read the bulletins referred to carefully.

The seed of the corn plant is produced for the purpose of perpetuating the species, and Nature does her work so well that practically every kernel that matures will grow. If, however, the seed be exposed to unfavorable conditions, its power to grow will be reduced or destroyed. It therefore becomes a matter of much more importance to preserve the vitality of seed corn than to attempt to separate

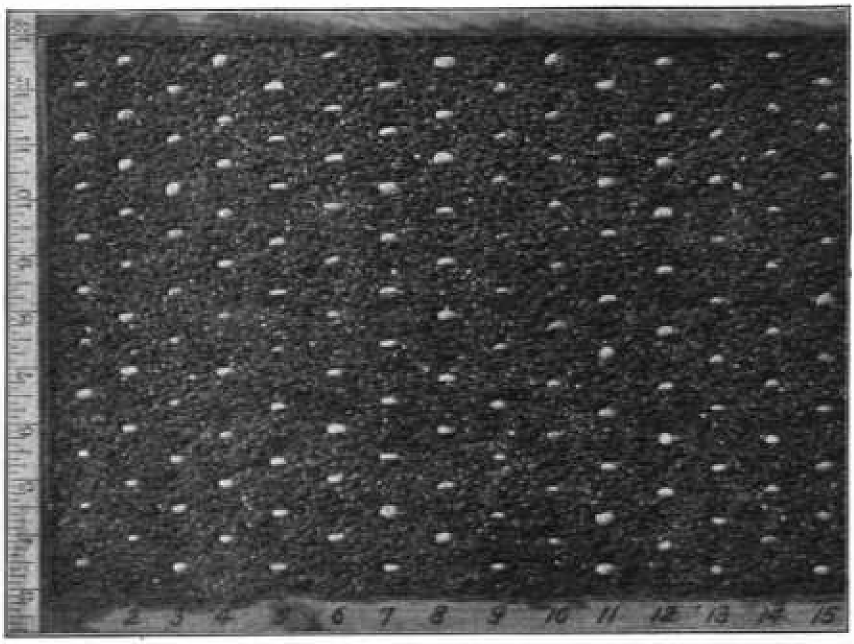

FIG. 9.—Means of testing the germinating power of individual ears.

by germination tests the poorest ears from poorly preserved seed. The fact that some ears have lost their vitality indicates that the vitality of other ears in the same lot of seed has been more or less injured.

Prevention is better than cure, even were a cure possible, which is not the case. The writer has yet to find an instance in which seed corn has not germinated satisfactorily when it has matured properly and received proper care from the time of maturity until tested the following spring. Unfavorable field conditions at planting time or soon after may cause seed of perfect germinating power to result in a poor stand.

The very early freezes that frequently occur in the Northern States before corn is fully ripe make it necessary that prompt attention be given to seed-corn selection in the North.

TESTING THE GERMINATION OF SEED CORN.

Seed corn should be so well cared for that it will contain no ears that will not germinate, and seed testing should be employed as a demonstration of the fact that the seed has received proper attention, rather than as a screen to separate the worthless from the poorly preserved seed. If through accident or carelessness a supply of seed has been so damaged that a test of 100 or more representative ears proves

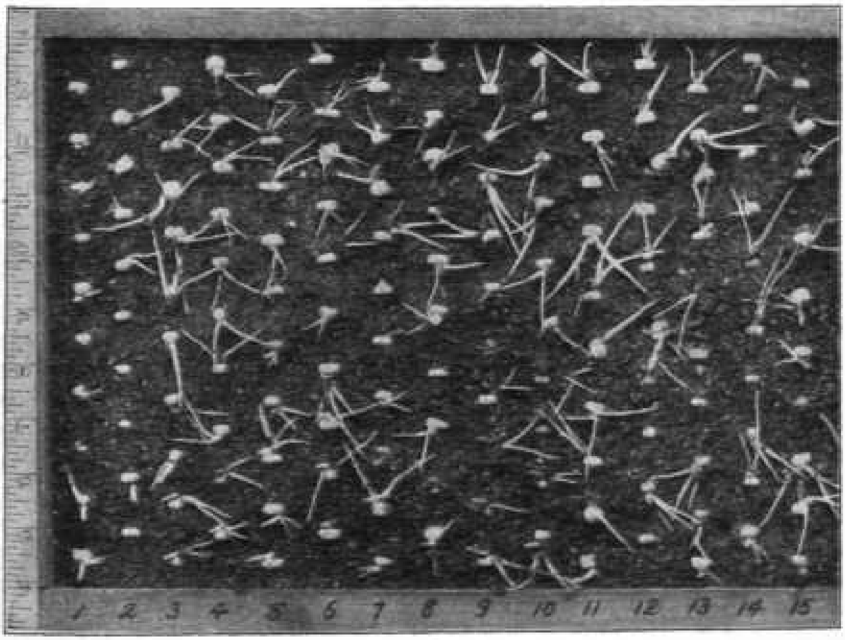

Fig. 10.—Same kernels as shown in Fig. 9, photographed five days later.

that less than 97 kernels out of every 100 germinate, and better seed can not be procured, it is certainly advisable to test the ears separately and discard the poorest.

This test can very easily be made by numbering the ears and then taking 5 (or 10) kernels from each ear and placing them in numbered rows in shallow boxes of moist sand, arranging them so that the kernels from ear No. 1 are in row No. 1, etc. Figure 9 shows a portion of such a box photographed just after 10 kernels from each ear were placed in the rows, and figure 10 the same rows five days later. If the boxes used are 2 or $2\frac{1}{2}$ inches deep and a damp cloth is spread over the top after the kernels are placed in the sand, no further atten-

tion will be necessary for five or six days, when the results of the test can be recorded. The box should be kept in a warm place where the temperature does not fall lower than 50° F.

CONCLUSIONS.

There is a general demand for well-bred seed corn.

Every geographic section of the United States where the soil or climatic conditions are distinctive needs one or more careful corn breeders.

Until the merits of a strain of corn and the honesty of the one who sells it are known, farmers should purchase sparingly and insist on receiving the seed as ear corn.

The most important character a corn can possess is ability to produce large yields. This important character can be greatly increased by persistent selection of good seed ears from the progeny of ears that have proved most productive.

Properly conducted corn-breeding work will prove highly profitable to the breeder and to the purchasers of the seed corn.

Vitality is preserved by thoroughly and quite rapidly drying the seed ears and storing them where they will not be exposed to damp atmospheres or sudden changes in temperature.

If found necessary to plant seed the vitality of which is at all doubtful, test each ear separately and plant only those which germinate perfectly.

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APPENDIX.

SELECTION AND CARE OF SEED CORN.

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Some farmers may not have the time to breed their seed corn or opportunity to purchase, as outlined in the foregoing paper. The crop depends largely on the seed, however, and no farmer can afford to neglect to save and select his seed corn by some careful method. Those who can not breed their own seed corn or buy carefully bred seed of suitable kind are urged to follow the best methods of selecting seed from their field crop, and to give the selected seed the best of care. The suggestions which follow may prove helpful in this work. They will also prove especially useful to the farmers who have purchased improved seed, and who wish to maintain the productiveness of the strain without purchasing new supplies of seed every year.

When to harvest seed corn.—It is important that the seed corn be thoroughly dried out before it is subjected to severe freezing. It is desirable to select the seed corn early in the fall, before there is danger of freezes. Light frosts would not injure the seed, but the selection should not be delayed too long, as a severe freeze might greatly injure the vitality of the seed if it was not thoroughly dried out when the freeze came.

Where to gather seed.—Select your seed from that portion of the field which is uniformly the best developed. It is a good practice to husk this portion of the field early in the season to be sure that those ears saved for seed will have been husked and preserved before freezes occur.

How to harvest seed in field.—Have a seed box attached to the wagon box, if the corn is husked in the field standing, and whenever an especially good ear is found throw it in the seed box. Don't be afraid of getting too many good ears, as they should be examined more carefully later and only the very best of them selected for planting. From two to three times as much seed should be selected at this time as will be necessary to plant the next year's crop.

How to harvest seed from shock.—If the corn is cut and shocked, that portion of the field from which seed corn is to be selected should be husked before freezes occur and the best ears selected and kept separate as in the preceding case.

How to preserve seed.—The seed corn selected as above indicated should be placed in a dry, well-ventilated room where the ears can be spread out. They should not be piled in a heap, as it is important to expose them to a free circulation of air, so that they will dry quickly and thoroughly without molding. It is a good practice, often followed, to leave a few husks attached to each ear, so that the ears may be tied together in pairs by means of the husks and then hung over poles or wires in the upper part of the room. If convenient, racks can be made like bookcases, with slat shelves about 4 or 5 inches apart, and open backs and fronts, in which the ears can be arranged until thoroughly dried. Only one row of ears should be placed on each shelf. This method allows the preservation of a large amount of seed corn in a small space.

Use of artificial heat in drying seed.—It has been found to be very important to dry out the seed corn quickly and thoroughly, and the use of some artificial heat is in most cases desirable. It is thus important, especially in damp, cold seasons, to place the seed corn in a room where there is a stove in which a fire can be maintained at least a portion of each day for about two weeks, or until the corn is thoroughly dried out. In favorable dry autumns artificial heat may not be necessary, but in many cases the "kiln drying" of seed, as it is called, will be found to be very important. In one experiment made by Mr. Hartley on the Department's experimental farms kiln-dried seed gave an average yield of 16 bushels per acre more than ordinary air-dried seed of the same variety grown in the same place. The experimental field in this case contained about 10 acres, and was planted with the air-dried and kiln-dried seed in alternate rows.

Selection of seed ears.—After the corn is thoroughly dried out, preferably some time in the winter, when farm work is not crowding, all the ears should be examined carefully, and a sufficient number of the very best and largest ears should be selected to plant the next year's crop. In making this selection the grower should carefully examine each ear, selecting those having deep and well-formed kernels, which will give the greatest weight of shelled corn per ear (see pp. 10 and 11). The imperfect kernels at the tips and butts of these selected ears should be shelled off and discarded before the ears are finally shelled for planting.

Testing the germination.—Test the germination and comparative vigor of growth of these seed ears, as already described (p. 19). If any of the ears give poor or slow germination or lack vigor, discard such ears.

Grading the seed corn to fit dropping plates.—A perfect stand is one of the principal factors in securing a good yield. If 3 or 4 stalks per hill is a perfect stand, hills with 1 or 2 or with 5 or 6 stalks will make a poor stand and give a loss in yield. It is important to have good seed of perfect germination, and to have the seed grains dropped uniformly, with the right number in the hill. It is thus desirable, as emphasized by Prof. P. G. Holden, of the Iowa Agricultural College, to separate the seed ears selected into three classes, or grades, having (1) small, (2) intermediate, and (3) large kernels, and shell and preserve these three grades of seed separately. Before beginning the planting, the planter can be carefully tested with each grade of seed, and the dropping plates with different-sized holes or marginal notches selected for each grade, which by careful trial are found to uniformly drop the desired number of kernels. These plates, after thorough test, can be marked, and used when needed with the proper size of seed grains without loss of time in the rush of planting.